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ORIGINAL ARTICLE

Factors Affecting Sleep Quality in Firefighters

Mahnaz Abbasi[1], Majid Rajabi[2], Zohreh Yazdi[2,3*], Ali Akbar Shafikhani[4]

[1]Associate Professor of Rheumatology, Metabolic Disease Research Center, Qazvin University of Medical Sciences, Qazvin, Iran
[2]Social Determinants of Health Research Center, Qazvin University of Medical Sciences, Qazvin, Iran
[3]Associate Professor of Occupational Medicine, Social Determinants of Health Research Center, Qazvin, Iran
[4]Department of Occupational Health Engineering, Qazvin University of Medical Sciences, Qazvin, Iran

ABSTRACT

Background: Identifying factors affecting the quality of sleep in firefighters is of significant importance. Good sleep is one of the essential needs of firefighters, and poor sleep quality impairs their performance and decision making. The present study aimed to evaluate sleep quality and its relation with ergonomic, demographic, and psychological factors in firefighters employed in Qazvin.

Methods: 118 firefighters from seven stations participated in this study. Data were gathered by questionnaires including demographic, Pittsburgh Sleep Quality Index, Beck Depression Inventory, HSE questionnaire for occupational stress, and Nordic questionnaire. Data were compared between two groups of firefighters with good and poor sleep quality. Then the data were analyzed using regression analysis.

Results: 59.3% of firefighters had poor quality of sleep. Univariate analysis showed a significant correlation between sleep quality with musculoskeletal disorders, shift work, body mass index (BMI), and stress ($P<0.05$). In multivariate analysis, all variables except the occupational stress maintained their significant relationship with sleep quality.

Conclusion: this study showed that musculoskeletal disorders (MSDs), shift work, and high body mass index are associated with poor sleep quality in firefighters. Proper timely interventions are suggested to prevent the complications of sleep disorders in firefighters.

Keywords: sleep quality, firefighter, depression, stress

INTRODUCTION

Sleep plays an important role in healing the body during night, for example; it is a mediating factor for proper regulation of glucose metabolism (Spiegel, Tasali, Leproult, & Van Cauter, 2009). Moreover, levels of hormones that control appetite are influenced by sleep condition (Karine, Esra, & Plamen, 2004). Sleep disorders and poor quality of sleep in people lead to reduced ability for work and low productivity. Also, they increase the incidence of occupational accidents. Therefore, understanding factors affecting sleep quality is important (Lohsoonthorn et al., 2013).

Shift work is one of the causes of sleep disorders. Working irregular shifts during 24 hours of day and night causes damage to biological rhythms of sleep and wakefulness which eventually leads to sleep disorders (Karine et al., 2004; Lohsoonthorn et al., 2013; Spiegel et al., 2009). Studies have shown that more than 60% of people who are shift workers are affected by sleep disorders (Fillingim, King, Ribeiro-Dasilva, Rahim-Williams, & Riley, 2009). Firefighting is one of the jobs which require shift work. To compound the situation, occupational stress is also very high in this job. These conditions justify the high prevalence of sleep disorders and poor quality of sleep in firefighters which is significantly higher than the general population (Fillingim et al., 2009).

In a study conducted in the United States, about 60% of firefighters suffered from sleep disorders (Carey, Al-Zaiti, Dean, Sessanna, & Finnell, 2011). In another study

***Correspondence:** yazdizohreh@yahoo.com
Zohreh Yazdi, Qazvin University of medical sciences, Qazvin, Iran
Tel number: 098 28 33365386 Fax number: 0098 28 33359503

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conducted in Iran in 2013, scores of Pittsburg Sleep Quality Index more than 5 (poor quality of sleep) were reported in 70% of firefighters (Mehrdad, Haghighi, & Esfahani, 2013).

Evidences suggest that one of the important factors affecting sleep quality is musculoskeletal pain. There is a complex relationship between pain and sleep, including the relationship between pain and sleep quality, and interference of pain with sleep continuity (Hurley et al., 2010). Using the firefighting equipment requires too much energy and awkward posture, thus prevalence of work-related musculoskeletal disorders (MSDs) in firefighters is high (Kang & Kim, 2008).

In addition, firefighters are exposed to physical risks, trauma and accidents during firefighting operations such as preventing and suppressing fire and emergency rescues. Such consequences may expose them to mental disorders including post-traumatic stress disorders, stress, and depression. It is believed that musculoskeletal pain is affected by mechanical and psychological factors, or independently associated with sleep disorders in firefighters (Harrison, Wilson, & Munafò, 2014). Studies have shown that post-traumatic stress disorders, musculoskeletal disorders, heart diseases, and oxidative DNA damage is higher in firefighters than the general population (Chen et al., 2007; Irie, Asami, Nagata, Miyata, & Kasai, 2001; Kim, Kim, Ryoo, & Yoo, 2013). Also, personal and occupational factors such as gender, age, physical activity during work, and education were associated with sleep quality which is mentioned in other literatures (Carey et al., 2011; Chen et al., 2007; Irie et al., 2001; Kim et al., 2013).

Identifying the factors responsible for the poor quality of sleep and targeting the underlying mechanisms that perpetuate insomnia in Iranian firefighters have special importance in taking some preventive and protective measures to address and resolve the issue effectively. Few studies have addressed the factors associated with poor quality of sleep in Iranian firefighters. The aim of this study was to evaluate sleep quality and its relationship with ergonomic factors (musculoskeletal disorders and shift work), psychological factors (stress and depression), and other demographic factors in firefighters employed in Qazvin.

METHOD

This is a cross sectional study that was conducted in Qazvin university of medical sciences (QUMS) in 1394. All firefighters who attended the occupational medicine clinic for periodic health examination were included. A total of 118 firefighters were enrolled from seven stations. This study was approved by the Ethics Committee of QUMS, and informed consent was obtained from all participants. Information was gathered by a comprehensive questionnaire.

Demographic data evaluation

The first part of the questionnaire was about demographic information including age, weight, height, body mass index (BMI), marital status, years of experience in their job, education, and physical activity level.

Sleep quality assessment

The second part of the questionnaire was about the quality of sleep assessment. The Pittsburg Sleep Quality Index (PSQI) was used to assess sleep quality of the participants over the past month. PSQI questionnaire consists of 19 items in a Likert scale of 4 degrees. Scores from seven domains of questionnaire are summed to create a total PSQI score with a maximum of 21. Scores higher is related to the quality of sleep are more unfavorable (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Reliability and validity of this questionnaire have been confirmed in other studies (Alsaadi et al., 2013; Farhadi Nasab & Azimi, 2008; Mollayeva et al., 2015). According to the designers of the questionnaire, a score greater than 5 indicates a poor sleep quality (Ağargün, Kara, & Anlar, 1996; Aloba, Adewuya, Ola, & Mapayi, 2007; Doi et al., 2000).

Evaluation of depression

The next section of the questionnaire contains the Beck Depression Inventory. This scale consists of 21 questions with a range of 0-3. Maximum score of this questionnaire is 63, and larger scores indicate higher degree of depression (Beck, Steer, & Brown, 1996; Erford, Johnson, & Bardoshi, 2015; Lasa, Ayuso-Mateos, Vazquez-Barquero, Dıez-Manrique, & Dowrick, 2000).

Job stress assessment

The next part of the questionnaire included Health and Safety Executive (HSE) stress questionnaire. This questionnaire consisted of 35 questions with 7 sub-scale including demand, control, managerial support, peers, relationship, role, and change. Each of the questions is scored from 1 to 5 where 1 is the desired state and 5 indicates a stressful state (Cousins* et al., 2004). Reliability and validity of this questionnaire have been desirable in the study of AZAD et al (AZAD & GHOLAMI, 2011).

Evaluation of the status of musculoskeletal disorder (MSDs)

Finally, the final section was a questionnaire on the evaluation of musculoskeletal disorders (Kuorinka et al., 1987). Nordic questionnaire was also used to determine the prevalence of musculoskeletal disorders in firefightersand another job (Abbasi, Yazdi, & Mahdavifar, 2016; Darvishi, Shafikhani, & Shafikhani, 2015; Deakin, Stevenson, Vail, & Nelson, 1994).

Data collection and statistical analysis

Data were analyzed using frequency and percentage for categorical variables and means and standard deviation for continuous variables. Independent t-test and chi-square test were used to compare continuous and categorical variables, respectively. First, the relationship between sleep quality and several explanatory variables was analyzed by univariate linear regression model. Then the relationship between the risk factors and sleep quality was determined using multivariate linear regression analysis. In both models, sleep quality was considered as a dependent variable where independent variables included physical activity level, BMI, age, shift work, depression, stress, education, and musculoskeletal disorders. All statistical analysis was performed using SPSS version 22, and p-value less than 0.05 was considered notably significant.

RESULTS

A total of 118 firefighters with an average age of 33.3±5.7 participated in this study. A total of 48 (68.6%) of the subjects had academic education (higher than the diploma level), and 62 (87.3%) subjects were married. 80 (67.8%) and 37 (31.4%) of firefighters had heavy and medium level of activity, respectively. Mean of BMI in participants was 24.2±4.7, which included one

Table 1. Relationship between demographic variables and sleep quality

	Sleep quality				P-value
	Poor sleep quality		Good sleep quality		
	mean	Standard deviation	mean	Standard deviation	
Age (year)	33.2	4.9	33.5	6.8	0.76
Years of employment	8.6	6.1	8.1	4.8	0.68
	number	percent	number	percent	p-value
Marriage status					
single	8	11.4%	7	14.6%	0.61
married	62	88.6%	41	85.4%	
Education					
Diploma	22	31.4%	14	36.3%	0.18
BSc	31	44.3%	17	35.4%	
MSc	17	24.3%	17	35.5%	
Physical activity					
heavy	54	77.1%	26	54.2%	0.016
Moderate	15	21.4%	22	45.8%	
light	1	1.4%	0	0	
BMI (kg/m^2)					
≤18.5	0	0	1	2.1%	<0.05
18.5-24.9	65	92.8%	45	93.1%	
≥25	5	7.2%	2	4.2%	

*age and years of employment are presented as mean and standard deviation.

**Marriage status, level of education, physical activity, and BMI are presented as number and percent.

underweight subject (0.8%) and 7 obese subjects (5.6%). Score of PSQI more than 5 were observed in 59.3% of the participants. Among them 48 (40.7%) had good quality of sleep and 70 (59.3%) had poor quality of sleep.

Table 1 shows characteristic of firefighters according to their sleep quality. As illustrated in the table, BMI and activity level were significantly higher in firefighters with poor quality of sleep (P<0.05). There was no difference in terms of other demographic variables such as age, duration of employment, marital status, and education (Table 1).

As shown in table 2, scores of occupational stress in firefighters with poor and good quality of sleep were 18.03±2.9 and 15.54±2.9, respectively (P<0.001). In a more detailed analysis, the most occupational stress in firefighters with poor quality was on the managerial support and relationship subscales. Firefighters with poor quality of sleep had more depression, and were more likely to have shift work schedule (P<0.05). Among all the participants, 49 (70%) with poor quality of sleep versus 15 (31.3%) with good quality of sleep had musculoskeletal disorders (Table 2, P<0.05).

In a more detailed analysis at these musculoskeletal disorders, it was found that only low back pain was associated with poor quality of sleep, and no significant relationship was found between sleep quality and other skeletal disorders. It should be noted that prevalence of depression (scores more than 10 in Beck depression questionnaire) in the participants was 17.8%.

Table 3 shows results from univariate analysis.

Table 2. Relationship between sleep quality with mental health, shift work, and musculoskeletal disorders

	Sleep quality				P-value
	Poor sleep quality		Good sleep quality		
	mean	Standard deviation	mean	Standard deviation	
Role	3.4	0.59	3.32	0.74	0.52
relationship	2.1	0.81	0.8	0.64	<0.001
managerial support	2.89	0.58	1.87	0.87	<0.001
Peers	2.69	0.84	2.68	0.77	0.95
Control	2.36	0.73	2.26	0.84	0.47
demand	2.12	0.74	2.3	0.73	0.22
Change	2.45	0.85	2.6	0.88	0.35
Total score of stress	18.03	2.91	15.84	2.96	<0.001
depression	5.14	5.41	6.2	6.02	0.31
	number	percent	number	percent	p-value
Shift work					
with shift work	44	62.9%	10	20.8%	<0.001
Without shift work	26	37.1%	38	79.2%	
MSDs					
with MSD	49	70%	15	31.3%	<0.001
Without MSD	21	30%	33	68.8%	

*stress and depression are presented as mean and standard deviation.

**shift work and MSDs are presented as number and percent.

Table 3. Results of linear regression analysis for relationship between sleep quality and independent variables

Variables	multi variables		Uni variables	
	BETA-VALUE	P-VALUE	BETA-VALUE	P-VALUE
Age	-.089	0.279	-.093	0.315
Education	-.124	.132	-.056	.550
Activity	-.026	.764	-.166	.073
MSDs	.178	.047	.313**	.001
Shift work	.199	.029	.336	<0.001
BMI	.319	<0.001	.366**	<0.001
Stress	.170	.062	.266**	.004
Depression	-.022	.793	-.086	.357

According to the B and P values, there is a significant positive relationship between sleep quality scores with independent variables including musculoskeletal disorders, shift work, stress, and BMI (P<0.05). In multivariate analysis, all variables except the occupational stress maintained their significant relationship with sleep quality.

DISCUSSION

The present study was performed to determine the underlying cause of the poor quality of sleep in firefighters of Qazvin province. There are some evidences signifying that good quality of sleep can protect human against a wide range of metabolic and nutritional disorders (Vorona et al., 2005).

Our results showed that there was a significant positive relationship between sleep quality scores with independent variables including musculoskeletal disorders, shift work, stress, and BMI (P<0.05). In multivariate analysis, all variables except the occupational stress maintained their significant relationship with sleep quality. Other results showed that increasing BMI in firefighters was significantly related to worse quality of sleep. Other cohort and cross sectional studies have shown confirming results to those of the present study (Kleiser, Rosario, Mensink, Prinz-Langenohl, & Kurth, 2009; Seegers et al., 2011). Other studies have shown that the activity of the brain (frontal cortex) increases in response to food stimuli in people with chronic sleep deprivation (Crispim et al., 2011). There are credible evidences that support the causal relationship between sleep deprivation and weight gain. Insomnia can cause obesity through fatigue and subsequent reduced physical activity (Keith et al., 2006). Research in this area has shown that prevention of pain related insomnia is possible. For this purpose, it is necessary to identify cognitive behavior factors related to insomnia at early stages. In this study, we tried to examine the link between sleep disorders and MSDs in firefighters, so that we can adopt an appropriate approach for the treatment and prevention of these disorders (Keith et al., 2006). One of the factors that cause pain related insomnia is physical activity, so this factor was entered in the regression model, but the results were not significant. Musculoskeletal disorders in firefighters were associated significantly with lower sleep quality. It is noted that this relationship was observed only between sleep quality and low back pain, and this association was not significant in other organs.

Alsaadi and his colleagues found similar results and showed that back pain and sleep disorders were associated with each other (Alsaadi et al., 2013). Sleep disorders can exacerbate pain and inflammatory processes. One reason for this relationship is a decrease in response of endogenous pain inhibitor with increasing severity of insomnia (Tang, Goodchild, Sanborn, Howard, & Salkovskis, 2012). There is a complex bilateral relationship between pain and mental health variables (stress and depression) (Salazar, Dueñas, Ojeda, & Failde, 2014). An important finding of our study was the relationship between mental health variables and sleep quality. In this study, these variables were entered in the regression model. Results showed that occupational stress was associated with poor quality of sleep at univariate model, and there was no significant relationship between depression and sleep quality.

The findings clearly show that occupational stress acts as an underlying cause for the development of MSDs. Therefore, reducing the risk of psychological factors is important for firefighters. In a study conducted by the Kim and colleagues it was shown that occupational stress and MSDs are prevalent among firefighters and an occupational stress management program is needed to reduce MSDs (Kim et al., 2013). Other studies show that stress and depression through increased sensitivity to pain can affect the sleep pattern. The co-existence of these conditions plays a synergistic effect. That's why people who have pain related sleep disorders are significantly more disable (Salazar et al., 2014).

In the present study a significant positive relationship was observed between sleep quality score and shift work schedule in participants. In a study by Lim et al a significant relationship was found between sleep disorders with MSDs, shift work, and depression. Some studies have shown that a vast majority of people who are shift workers suffer from some degrees of shift work sleep disorders

(Lim, Baek, Chung, & Lee, 2014). The prevalence of depression in among the participants of the present study was 17.8% which may, in part, be due to an increased workload and a role conflict.

In a study conducted by Szuubert and his colleagues, 33% of firefighters had depressive symptoms. Likewise, in this study, the rate of depression in firefighters who work in the firefighting section was two times higher than those who were working in other departments (Szubert & Sobala, 2001). In the present study, 59.3% of participated firefighters had PSQI scores more than 5 (poor quality of sleep). In a similar Brazilian study that was conducted in 2012, 51% of firefighters were suffering from sleep disorders (de Barros, Martins, Saitz, Bastos, & Ronzani, 2012). Other studies confirmed the findings of this study, and have shown that sleep disorders in firefighters is higher than general population (de Barros et al., 2012; Szubert & Sobala, 2001).

It should be noted that this study was a cross sectional study. Therefore, more cohort studies are needed to determine the causal relationship between factors involved in this topic. This study attempted to assess factors associated with sleep quality including ergonomic, psychological, and demographic factors in firefighters. Due to the negative impacts of insomnia and other sleep disorders on productivity and safety in the workplace, findings of this study can be effective in providing corrective and preventive strategies. Improvement in this area of knowledge (sleep disorders) and associated factors can be effective in finding appropriate strategies to solve firefighters' problems and improve their quality of life.

CONCLUSION

This study found that sleep quality is associated with some independent variables such as musculoskeletal disorders, shift work, and body mass index. It is important to bear in mind that early detection of sleep disorders makes treatment faster and more convenient. Therefore, appropriate strategies are required for preventing complications of sleep disorders. Considering all the factors affecting sleep quality in firefighters is essential for this purpose which was considered in this study as far as possible. More studies are needed to clarify this relationship further.

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Author contribution:
Mahnaz Abbasi: design, data gathering, manuscript preparation
Majid Rajabi: data gathering
Zohreh Yazdi: design, data gathering, analysis, manuscript preparation
Ali Akbar Shafikhani: data gathering

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